US-PAT-NO: 6343098

DOCUMENT-IDENTIFIER: US 6343098 B1

TITLE: Efficient rate control for multi-resolution video encoding

DATE-ISSUED: January 29, 2002

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Boyce; Jill MacDonald	Manalapan	NJ	N/A	N/A

APPL-NO: 09/ 031035

DATE FILED: February 26, 1998

US-CL-CURRENT: 375/240.03

ABSTRACT:

The invention provides a multi-resolution video encoding system which improves the computational efficiency associated with encoding a video sequence in two or more different resolutions. An illustrative embodiment includes a first encoder for encoding the sequence at a first resolution, and a second encoder for encoding the sequence at a second resolution higher than the first resolution. Information obtained from encoding the sequence at the first resolution is used to provide rate control for the sequence at the second

resolution. This information may include, for example, a relationship between a quantization parameter selected for an image at the first resolution and a resultant output bitrate generated by encoding the image using the selected quantization parameter. The invention can be used with a variety of video encoding standards, including H.261, H.263, Motion-JPEG, MPEG-1 and MPEG-2.

30 Claims, 5 Drawing figures

Exemplary Claim Number: 1

Number of Drawing Sheets: 4

---------- KWIC ---------

Brief Summary Text - BSTX (5):

The **MPEG**-2 standard implements multi-resolution video encoding through a process known as spatial **scalability**. This involves encoding a base layer of the video at a lower resolution and one or more enhancement layers at higher resolutions. The base layer is then transmitted to all receivers in a multipoint transmission application, and the enhancement layer or layers are transmitted only to the higher bandwidth receivers. However, **MPEG**-2 spatial **scalability** requires the higher bandwidth receiver to decode two or more layers, which increases the computational complexity of the decoding process. In addition, the bandwidth required for transmitting two or more layers is generally higher than that required for

transmitting a single bitstream encoded at the higher resolution. Additional detail regarding these and other aspects of the MPEG-2 standard are described in greater detail in "Information Technology Generic Coding of Moving Pictures and Associated Audio Information: Video," ISO/IEC DIS 13818-2, which is incorporated herein by reference.

Brief Summary Text - BSTX (14):

An exemplary rate control process implemented in the above-described illustrative embodiment may first determine target bitrates for different types of images at each of the first and second resolutions. The target bitrates may be set independently for each of the first and second resolutions, or alternatively maintained in a fixed ratio. The process then utilizes a rate-quantization model to select a quantization parameter for use with a given one of the images of the sequence at the first resolution. The selected quantization parameter is the quantization parameter which best matches the target bitrate for the first resolution. An estimated bitrate is determined for the image at the first resolution to be encoded using the selected quantization parameter, by dividing the target bit rate for the second resolution by a factor. The rate-quantization model is then used to determine a quantization parameter for an image at the second resolution, by finding the best quantization parameter for encoding the image at the first resolution to achieve the estimated number of bits for the image.

The above-noted factor may be updated as the sequence is encoded by, for example, recomputing it as a **moving average** of the ratio between: (1) an actual number of bits used when encoding the image at the second resolution using the determined quantization parameter, and (2) the number of bits which the rate-quantization model estimates will be required for encoding the image at the second resolution.

Detailed Description Text - DETX (12):

where FACTOR is defined in the manner previously described. The rate-quantization model is then used in step 106 to determine QP.sub.CIF. This involves finding the best QP for encoding the QCIF frame to achieve EB.sub.QCIF bits for the frame. The resulting QP.sub.CIF is then used to encode the corresponding CIF frame in step 108. The value of FACTOR is updated in step 110. This update may involve, for example, recomputing FACTOR as a **moving average** of the ratio between: (1) the actual number of bits used when encoding the CIF frame using the quantization parameter QP.sub.CIF in step 108, and (2) the number of bits which the rate-quantization model estimates will be required for encoding the QCIF frame using the same quantization parameter QP.sub.CIF.

Claims Text - CLTX (16):

13. The method of claim 11 further including the step of updating the factor by recomputing it as a **moving average** of the ratio between (1) an actual

number of bits used when encoding the image at the second resolution using the
quantization parameter for the image at the second resolution, and (2) the
number of bits which a rate-quantization model estimates will be required for
encoding the image at the second resolution using the same quantization
parameter.

Claims Text - CLTX (32):

26. The apparatus of claim 24 wherein the processor is operative to update
the factor by recomputing it as a **moving average** of the ratio between (1) an
actual number of bits used when encoding the image at the second resolution
using the quantization parameter for the image at the second resolution, and
(2) the number of bits which a rate-quantization model estimates will be
required for encoding the image at the second resolution using the same
quantization parameter.